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Fig. 1.

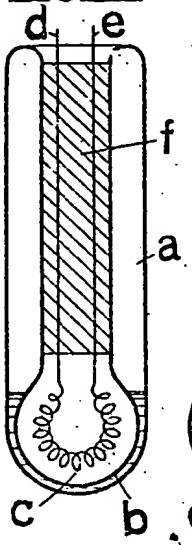


Fig. 3.

Fig. 4.

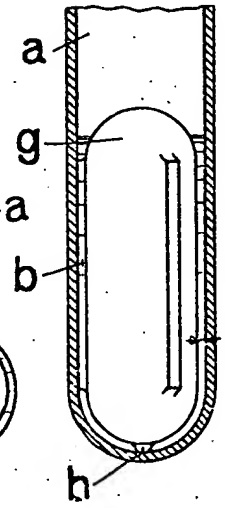


Fig. 6.

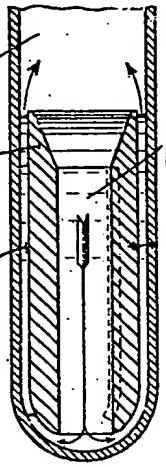


Fig. 8.

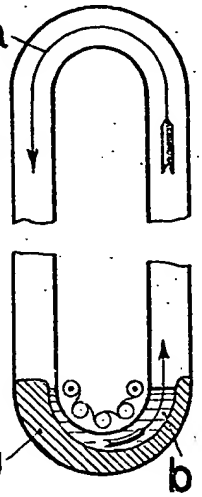


Fig. 2.

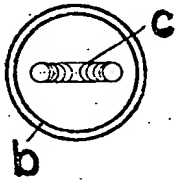


Fig. 5.

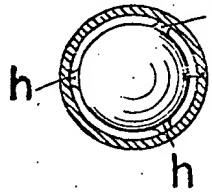


Fig. 7.

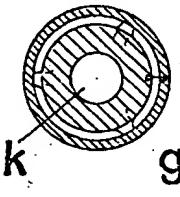


Fig. 9.

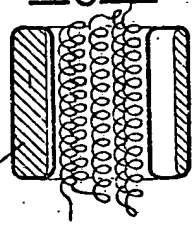


Fig. 14.

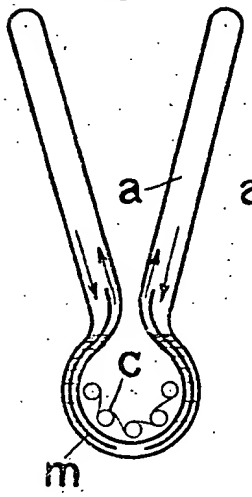


Fig. 10.

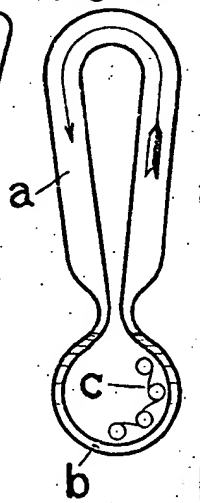


Fig. 12.

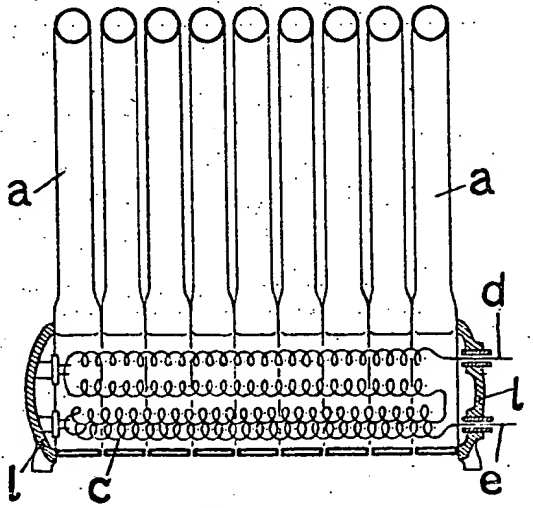


Fig. 11.

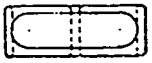
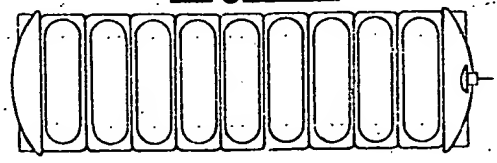


Fig. 13.



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NOTE.—*The application for a Patent has become void.*
This print shows the Specification as it became open to public inspection.

PATENT SPECIFICATION

128,898

Convention Date (Switzerland): June 22, 1918.

Application Date (in United Kingdom): Feb. 5, 1919. *No. 2848/19.*

Complete not accepted.

COMPLETE SPECIFICATION.

Improved Method and Apparatus for Heating Inhabited Rooms.

I, ERIC BROWN, of Bahnhofweg, Baden, Switzerland, Engineer, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

The heating of inhabited rooms by electrical energy is effected generally by heating air by means of resistances that are heated by electric current. That method has the drawback that the heat of bodies of small surface and high temperature must be transmitted directly to the air, so that the said air is driven in the form of a column of hot air of comparatively small volume with great force up against the ceiling of the inhabited room. The consequence of this is that the ceiling of the living room receives the greater portion of the generated heat, and the total efficiency of the heating of the room is lowered because the heat does not reach the lower parts of the inhabited room.

The improved method of the present invention obviates those drawbacks by transmitting the heat from the source of heat into the room by means of a circulation (maintained by evaporation and condensation) of a body of liquid contained in a closed hollow body in which the pressure is below that of the atmosphere: this transmission being effected substantially by direct radiation from uniformly heated surfaces of moderate temperature.

For carrying this improved method into effect, an improved apparatus is employed consisting of a closed hollow body in which the pressure is below atmospheric pressure, and which contains a limited quantity of liquid. The lower part of said hollow body which contains the liquid and serves for absorbing the heat is placed as near as possible to the source of heat, whereas the upper portion of the said hollow body that serves for giving off heat is in contact for a suitable extent of its area with the air of the room to be heated.

An apparatus of this kind is illustrated by way of example in Figure 1, in longitudinal section and in Figure 2 in cross section. A double-walled hollow body *a* preferably formed as a body of revolution, contains the body of liquid in its lower part and encloses the electrical heating resistance *c*. The leads *d* and *e* to this resistance pass through the mass *f* that serves to close the heating chamber. The electrical current supplied through the leads *d* and *e* raises the resistance *c* to a high temperature, so that the heat generated in the said resistance is transmitted to the liquid *b* contained in the hollow body *a*. This liquid is under a pressure below that of the atmosphere, and in the case of a complete vacuum will boil at a temperature of a few degrees above 0° C. The resulting vapour rises in the chamber *a* and is condensed on the walls of the latter. It thereby distributes the heat uniformly over the entire surface of the hollow body which gives off the said heat through its walls to the sur-

[*Price* 1/-]

rounding space. By suitably regulating the electrical current and the quantity of heat generated by the latter, it is possible to maintain the temperature of the hollow body at any desired degree corresponding to any boiling point for pressures below the atmosphere. Instead of an annular cross-section the hollow body may have a cylindrical cross-section. In this case the leads pass from below to the electrical heating resistance as shown in Figure 3.

In order to prevent effectually a dangerous straining of the hollow body by reason of a too high vapour pressure, the quantity of the liquid can be made so small in proportion to the capacity of the hollow body, that no dangerous excessive pressures will be produced, even if the liquid by overheating is entirely evaporated.

In cases where, in consequence of the use of a very limited quantity of liquid, the surface area wetted by the liquid would be too small, this surface area which is necessary for absorbing the heat, may be increased by reducing the cross-section of the lower part of the hollow body containing the liquid to such a dimension as will ensure the spreading of the liquid over a sufficiently large surface area.

This reduction of the cross section of the hollow body may be effected in various ways. For instance, the shape of the hollow body may be suitably modified by bringing its walls nearer together as is shown in the example illustrated in Figs. 1, 2 and 3.

For the purpose of reducing the cross-section in the lower part of the hollow body which is to be filled with the liquid, a special displacing body may be inserted therein. The lower part of a hollow body of this kind is heated from the outside, is illustrated in Fig. 4 in longitudinal section and in Fig. 5 in cross-section. *g* is the displacing body, which is supported by projection *h* against the inner limiting surface of the hollow body *a* in such a manner that the liquid *b* that is displaced by it, is caused to wet the inner limiting surface of the hollow body to the extent required for the absorption of heat, in a layer having a thickness *i*.

In order to generate a circulation of the liquid suitable for a good absorption of heat, the displacing body *g* may as shown in Figures 6 and 7, be formed with one or more passages *k* which convey the condensed liquid to the lowest point of the hollow body and thereby produce a circulation of the liquid in the direction indicated by the arrows.

The circulation of the liquid required for a rapid absorption and giving up of heat, may be rendered very effective by constructing the hollow body in the form of a loop. A constructional example of this kind is illustrated in Figure 8 in longitudinal section and in Figure 9 in cross-section. The hollow body *a* consists of a flattened tube returning into itself which contains the liquid *b* in its lower part. In order to produce a circulation of the liquid in a determined direction, the displacing body *g* is made non-symmetrical in such a manner that the liquid cross-section is smaller on one side than on the other. This arrangement produces a movement of the liquid and of the resulting vapour in the direction of the larger cross-section, because the vapour encounters less resistance to its escape on the side of the larger cross-section.

A similar action upon the circulation of the liquid may be produced in the case of a symmetrical arrangement of the liquid cross-section on both sides by a one-sided arrangement of the source of heat. Figure 10 illustrates an arrangement of this kind of the electrical heating resistance *c*. The one-sided generation of the vapour produces a circulation of the vapour and condensed liquid in the direction of the arrow shown in the figure.

The construction of heating elements according to this invention has also great advantages in the matter of their manufacture. One form of improved heating element as shown in Fig. 10 consists of a tube closed upon itself the lower portion of which, containing the liquid *b*, is flattened by pressing or rolling, and is bent out to receive the heating resistance *c*. Figure 11 is a plan of this improved heating element. The flattening of the portion containing the liquid may be effected in such a manner as to render the liquid cross-section different on the two sides of the heating element. This construction produces a circulation of the liquid in the direction of the increased cross-section in the same way as is effected by the one side arrangement of the displacing body *g* shown in Fig. 8.

Improved heating elements of the kind illustrated by way of example in Figs. 10 and 11 may be assembled to form an improved heating body of the kind illustrated in Fig. 12 in longitudinal section and in Fig. 13 in plan for the purpose of obtaining the requisite surface for uniform heating of the living room with a moderate temperature of the heating body.

The lower parts of the heating elements *a* are shown arranged side by side, close

together, or connected together at the narrow sides of their flattened surfaces, and forming with the covers *l* provided at both ends a closed chamber in which the electrical resistance *c* is inserted with the leads *d* and *e*.

The improved heating elements instead of being constructed in the form of closed loops as illustrated in Fig. 10, may be made open in the form of double-legged tubes, the middle portion of which is flattened and bent out to receive the source of heat *c* as shown in Fig. 14. This construction allows of a particularly simple manufacture of the elements. In order to produce a suitable circulation of liquid in elements of this kind, the lower portion of the element containing the liquid may be divided longitudinally by a partition *m* that is interrupted at the lowest point of the element. The generation of the vapour will then preferably take place in the portion of the liquid that is contained between the said partition and the limiting wall nearest the source of heat of the element.

Other sources of heat having small surfaces and high temperatures besides electrical heating resistances may be employed. The form of the elements and of the heating bodies composed of the latter may be adapted in each case to the requirements of the room to be heated. For instance, the elements may be placed under the seats of a closed vehicle in the manner of a central heating installation having a common source of heat.

Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed, I declare that what I claim is:—

1. A method of heating inhabited rooms characterised by the feature that the heat is transmitted from the source of heat into the living room by means of a circulation (maintained by evaporation and condensation) of a body of liquid contained in one or more closed hollow bodies whose internal pressure is below atmospheric pressure, this transmission of heat being effected substantially by direct radiation from surfaces of moderate temperature.

2. Apparatus for carrying into effect the method claimed in Claim 1, comprising a closed hollow body whose internal pressure is below atmospheric pressure, containing a limited quantity of liquid, and having its lower part that contains the liquid and serves to absorb the heat, situated as near as possible to the source of heat, whereas its upper part that serves to give up the heat has a suitable area of its external surface in contact with the air of the room to be heated.

3. Apparatus as claimed in Claim 2, wherein the lower part of the hollow body is reduced in cross-section for the purpose of causing the liquid to wet the wall of the said hollow body over the area required for absorbing the heat.

4. Apparatus as claimed in Claim 2, wherein a displacer body partially displacing the liquid is inserted into the lower part of the hollow body for the purpose of causing the liquid to wet the wall of the hollow body over the area required for absorbing the heat.

5. Apparatus as claimed in Claim 4, wherein the displacer body is formed with passages for promoting the circulation of the liquid.

6. Apparatus according to Claim 2, wherein the hollow body is constructed in the form of a tube closed upon itself in the shape of a loop for the purpose of producing the circulation of the liquid in said loop.

7. Apparatus as claimed in Claim 6, wherein in the lower part containing the liquid the cross-sections of the two lengths of the loop-shaped hollow body are of different sizes for the purpose of producing a circulation of the liquid from the side of the smaller cross-section towards the side of the larger cross-section.

8. Apparatus as claimed in Claims 6, wherein the source of heat is arranged non-symmetrically to the two legs of the loop-shaped hollow body for the purpose of producing a circulation of the liquid in a direction from the less heated leg towards the more highly heated leg.

9. Apparatus as claimed in Claim 2, wherein the hollow body is constructed in the form of a double-legged tube which is provided in its lower portion connecting the two legs and containing the liquid, with a partition that is interrupted at the lowest point of the hollow body and produces a circulation of the liquid in each leg from the space comprises between the partition and that wall of the tube nearest the source of heat towards the space that is situated on the other side of the said partition.

10. Apparatus as claimed in Claim 2, composed of a plurality of hollow bodies assembled together in such a manner as to enclose a common source of heat.

11. Apparatus as claimed in Claim 2, wherein a plurality of hollow bodies similar to one another have their lower parts enclosing the source of heat assembled together in such a manner as to form a

closed space for the reception of a common source of heat.

12. The improved method of heating inhabited rooms substantially as hereinbefore described.

13. The several forms of improved apparatus for heating inhabited rooms, constructed and operating substantially as hereinbefore described and also as illustrated in and by the accompanying drawings.

Dated this 16th day of January, 1918.

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